Jet Propulsion Laboratory
California Institute of Technology

Combining paleo records, tide gauges, and process estimates to constrain 20th-century sea level rise in the South Atlantic Ocean

Thomas Frederikse, Surendra Adhikari, Tim J. Daley, Sönke Dangendorf, Roland Gehrels, Felix Landerer, Marta Marcos, Thomas L. Newton, Aimée Slangen, Guy Wöppelmann

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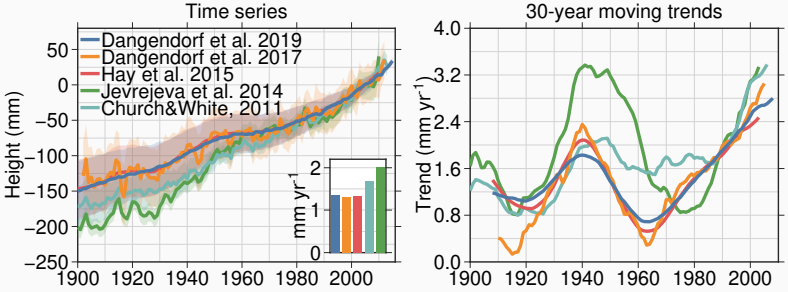
Twentieth-century sea-level rise reconstructions



- Trends and multidecadal variability differ between reconstructions

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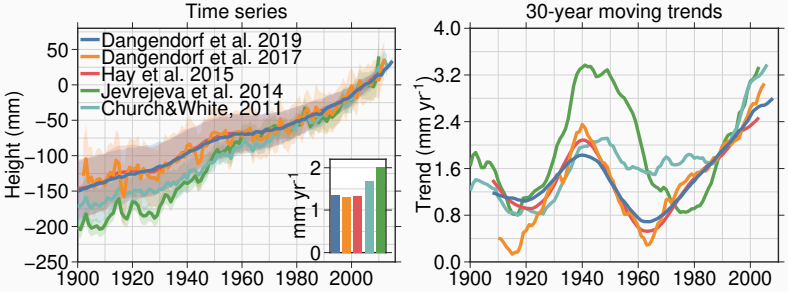
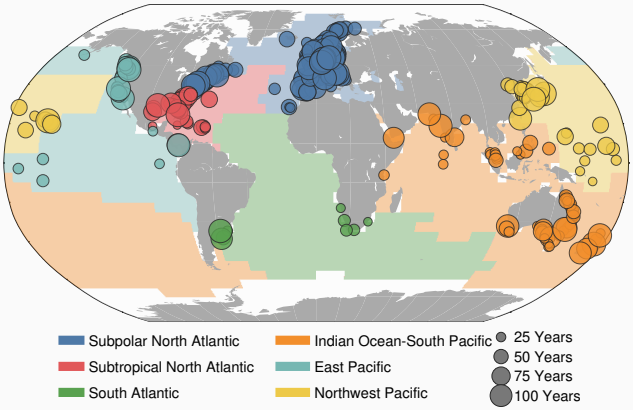
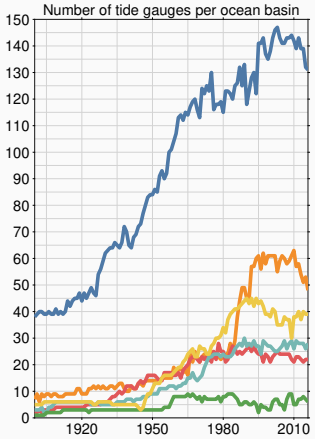


- Trends and multidecadal variability differ between reconstructions
- Uncertainty partially caused by sparse tide-gauge availability

Twentieth-century sea-level rise and tide-gauge deserts





- Large parts of the ocean go unobserved

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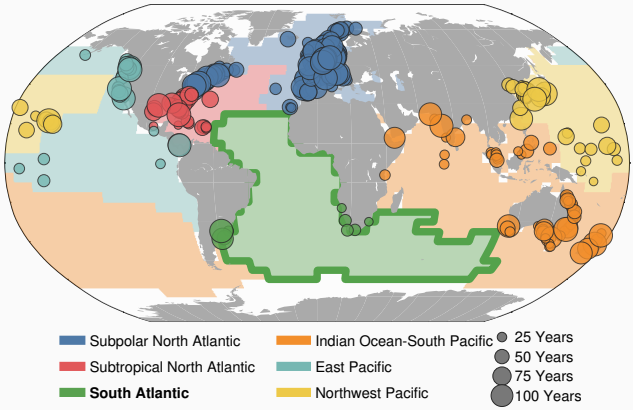

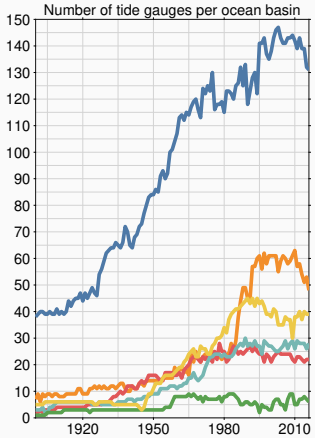

- Large parts of the ocean go unobserved
- Can we better constrain 20th-century sea-level rise in the South Atlantic?

Two approaches to better constrain sea level

Can we find extra observations?

- We use a new sea-level proxy from a Falklands salt marsh.
- Due to data rescue we have a new long tide-gauge record from Dakar, Senegal

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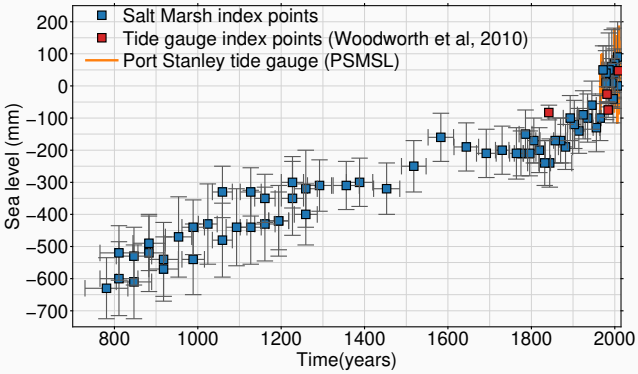
Do we expect sea-level changes in the South Atlantic that differ from the global mean?

- Could glacial isostatic adjustment, ice mass loss or ocean dynamics cause large differences between the South Atlantic and the global mean?
- What do CMIP5 models tell us?

A new salt-marsh record from the Falklands



Salt marsh proxy with high temporal resolution (Tom Newton's PhD thesis, Univ. Plymouth)

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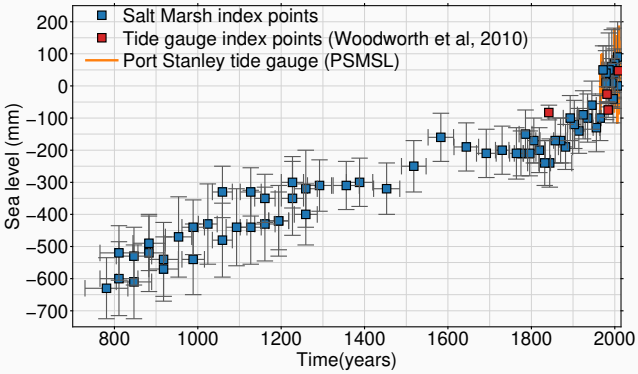

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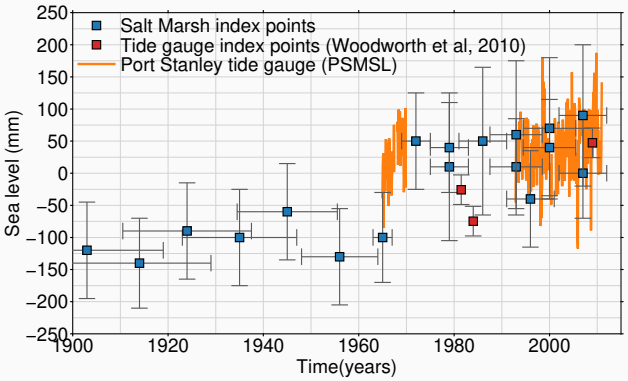

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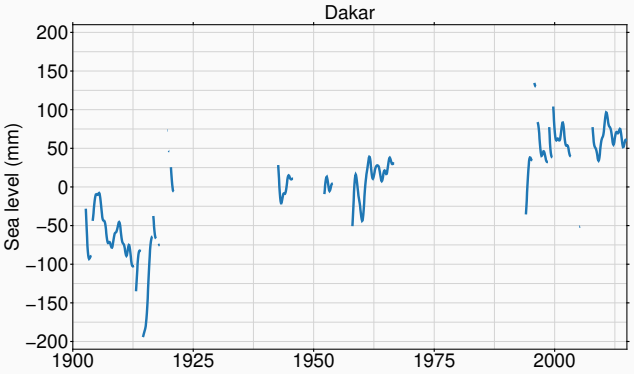
Many index points in 20th century

Data rescue from Dakar



Data rescue efforts have led to a long record that essentially covers the whole century

Benchmark information has been found as well

From individual records to basin estimates

With these new estimates, can we compute an updated estimate of sea-level change in the South Atlantic?

Yes! But we should keep in mind that:

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We can estimate and correct for these effects using GPS, GIA models and mass redistribution estimates

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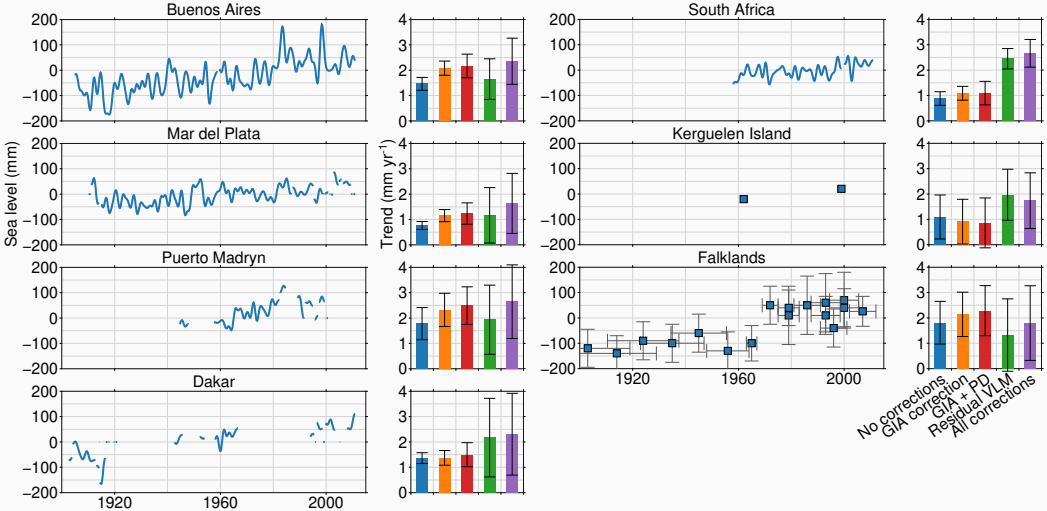

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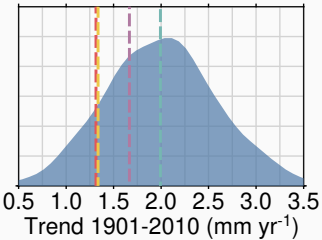

- Sea-level rise in South Atlantic likely larger than global mean

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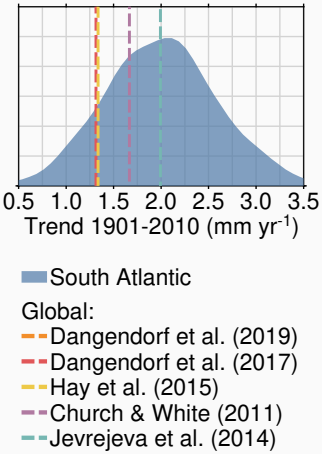

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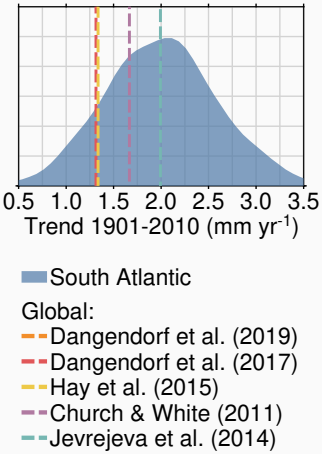

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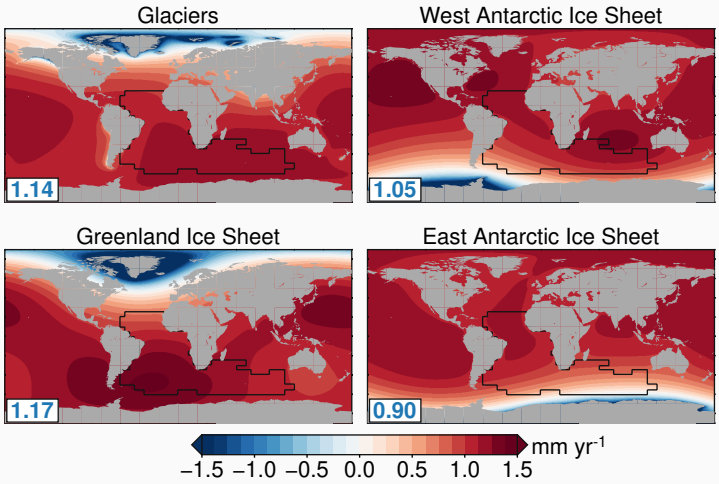
Can we find a physical explanation for this difference?

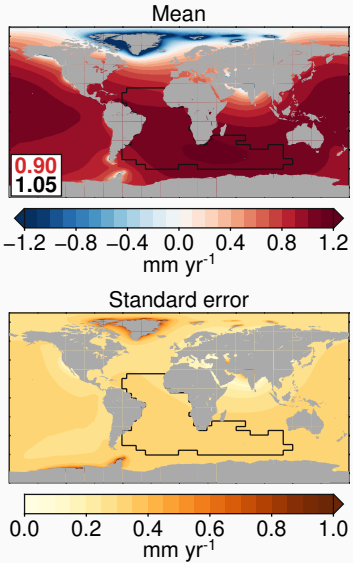
Could it be ongoing mass redistribution?



Number shows sea level rise (m) in South Atlantic when global-mean sea level would rise by 1 m.

Ice mass loss results in above-average sea-level rise in the South Atlantic, except for East Antarctica

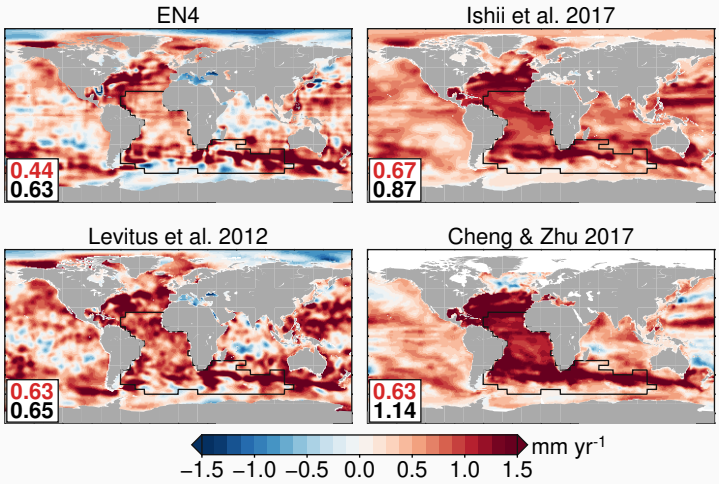
Could it be ongoing mass redistribution? Yes!



Estimates of 20th-century mass redistribution from Adhikari et al (2019)

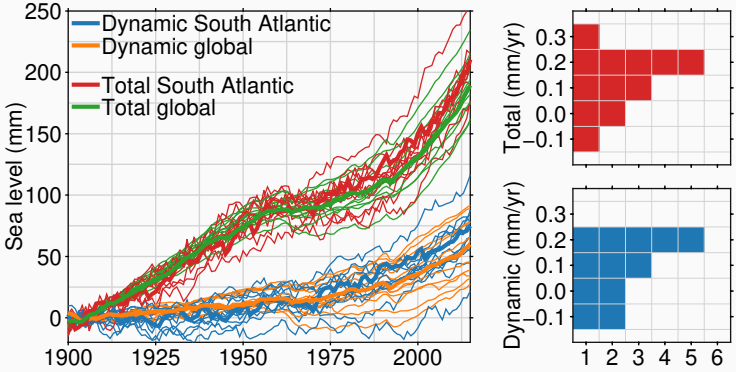
- Difference of 0.15 mm/yr between South Atlantic Ocean and global mean

Could it be ocean dynamics?



- All estimates show above-average steric trends (1955-2010)
- Representative for the 20th century?

What do CMIP5 models estimate?



- South Atlantic versus global mean (From Meyssignac et al. 2018)
- Both dynamic and total sea level show above-average South Atlantic MSL rise
- Difference on the order of 0.2 mm/yr

Summary

- We have estimated 20th-century sea-level rise in the South Atlantic 'tide gauge desert'
- Old and new sea-level records point at a larger sea-level trend than the global mean
- Ocean dynamics and mass redistribution allow for such a difference

Paleo proxies and data rescue efforts are valuable to improve our understanding of 20th-century sea-level changes, which are still not fully constrained!